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Soil Fertility Evaluation and GPS-GIS based Soil Nutrient Mapping of Maddikonda Village, Aswaraopet, Telangana

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ABSTRACT: Soil and land resources of Maddikonda village are diversified in nature and characteristics in supplying nutrients and providing necessary anchorage for the crop growth and development. There are number of variations in growth and disparities in the packages adopted by farmers. In the study area as a result of non-addition of organic manures, and primarily depending on chemical fertilizers, most of the soils exhibiting number of nutrient deficiencies *i.e.* N, P, K. The increasing nutrient deficiency retards the crop growth, yield and their quality characteristics. Keeping in view of problem, in the present investigation the fertility status of the soils of Maddikonda village, Bhadradri Kothagudem district of Telangana was evaluated on key parameters *viz.*, physico-chemical, available macro nutrient status using Nutrient Index approach by analysing 131 surface soil samples for pH, Electrical Conductivity (EC), Organic Carbon (O.C.), Nitrogen (N), Phosphorus (P) and Potassium (K). The Results of the study revealed that soils of the soils of Maddikonda village are very strongly acidic to neutral in reaction (4.19 to 7.54) with a soluble salt content ranges from 0.02 to 0.24 dS m^{-1} (Non-saline) and organic carbon content varied from 0.39 to 0.52% (low in status). The nitrogen status varied from 88.2 to 403.2 kg ha^{-1} and most of the soils of field cropped area are low in nitrogen status, soil phosphorus status ranged from 6.5 to 88.6 kg ha^{-1} and most of the soils are medium to high in phosphorus and potassium ranges between 57.8 to 310.1 kg ha^{-1} which indicates low to medium in potassium status.

Keyword: Nutrients index, soil physico chemical properties, nutrient mapping.

INTRODUCTION

The major problem facing during recent years is decrease in soil fertility and soil health which is essential for meet the food security. Over a period of time indiscriminate use of fertilizers has lead to the built-up of some nutrients like P and deficiency of K and Zn in many locations (Raj Setia *et al.*, 2012). Within cultivated fields, there is site specific management essentiality which can attain through spatial variability characterization of soil properties also referred to as precision agriculture practice. Geographical information system (GIS) is a computer based system for capturing, storing, querying and displaying geographical data (Chang, 2002). For easy accessing the retrieval and manipulation of voluminous data for natural resources that are often difficult to handle manually was done by using using GIS and GPS (Mandal and Sharma 2009). Compared to another geo-statistical methods, widely used method is ordinary kriging is to map spatial variation of soil fertility as it aids in providing high level of prediction accuracy (Song *et al.*, 2013). Mapping results can aid in effective monitoring of fertility status. Hence an attempt have done for mapping the soil fertility with the help of GIS and GPS mapping of Maddikonda village which is useful for fiving fertilizer recommendation and increase soil sustainability.

MATERIALS AND METHODS

Maddikonda village an adopted village of Agriculture College Aswaraopet which was established under Professor Jayashankar Telangana State Agricultural University (PJTSAU), Bhadradri Kothagudem District in Central Telangana Zone (CTZ). The village is located at 17.29´N latitude and 81.06' E longitude of Telangana. The zone is characterized by annual rainfall ranges from 779 to 1213 mm, received mostly from south-west monsoon. During this season maximum temperature ranges between 29°C and 39°C and minimum between 16°C and 25°C. The CTZ of Telanagana have 19 types of soils. Out of which major types are red shallow gravelly soils (12.4%), red clayey soils (12.2%), deep calcareous soils (9%), red gravelly loam (8.5%) and colluvial soils (8% of the area). Red soils, in this zone occupy 54 percent and are followed by calcareous soils (13%), colluvial soils (8%) and black soils (6%). A total of 131 samples were collected based on soil characteristics, cropping pattern and irrigation source. The samples collected were labeled properly, air-dried and processed for different soil parameters analysis. The physico-chemical properties of soil (pH and EC) were determined by standard procedures (Jackson 1973; Walkley and Black 1934) was used for organic carbon content. Available nitrogen (N) was analysed with alkaline permanganate method (Subbaiah and Asija 956). Sodium bicarbonate (0.5N $NaHCO_3$) extractant at pH 8.5 used for available

phosphorus (P) (Olsen *et al.*, 1954) and available potassium (K) was determined with neutral normal ammonium acetate on flame photometer (Muhr *et al.*, 1965). The classification of soil samples based on soil test values of different nutrients into three categories *viz.*, low, medium, and high was done by using index method and it is calculated as per the following equation.

NIV = (NL × 1 + NM × 2 + NH × 3)/100

where, NL, NM and NH are the number of samples in low, medium and high fertility classes of nutrient status, respectively and NT is the total number of samples. The index values are rated into various categories *viz.*, low (<1.67), medium (1.67-2.33) and high (>2.33) for OC and available N, P and K. Soil fertility maps was generated by krigging method using Arc-GIS software by importing database of soil nutrient Status into GIS environment.

RESULTS AND DISCUSSION

A. pH and Electrical Conductivity

In Maddikonda village soil pH ranged from strongly acidic to neutral in condition with mean pH 5.31 which was represented in Fig. 1 . Among 131 analysed soil samples most of the samples showed strongly acidic (65%) followed by slightly acidic (21%). Similar results were observed by Upadhyay *et al.* (2020); Satriawan *et al.* (2021) and Naidu *et al.* (2022). The results revealed that the soils were found to be completely non-saline (100%) based on EC values of tested samples as showed in Fig. 2.

(i) Organic Carbon. The organic carbon content analysis in soil samples showed that there was low organic carbon content in all soil samples (100%) with a mean of 0.45%. Similar observations were recorded by Raj *et al.* (2020) in soils of Telangana.

B. Available Major (N, P and K) Nutrient Status

The available nitrogen content ranged from 88.2 to 403.2 kg ha^{-1} with a mean nitrogen content of about 185.20 kg ha^{-1}. Most of the soils of field cropped area are low in nitrogen status (96%) represented in figure.3 due to sandy nature of soils and deviation from organic manures. Therefore there is need for addition of organic manures and inorganic material which will help in increasing availability of nitrogen. The results were in confirmation with Prasad *et al.* (2022).

The soil samples contain available phosphorus content with mean 34.5 kg ha^{-1} and ranged between 6.5 to 88.6 kg ha^{1} were as shown in figure 5. Most of the soils of field cropped area are medium to high in phosphorus might be due to dominance of 1:1 type of clay mineral (red soils), high dosage of phosphorous fertilizers and topdressing of phosphorous fertilizers through complex fertilizers. The results were in conformity with the findings of Mahesh *et al.* (2018).

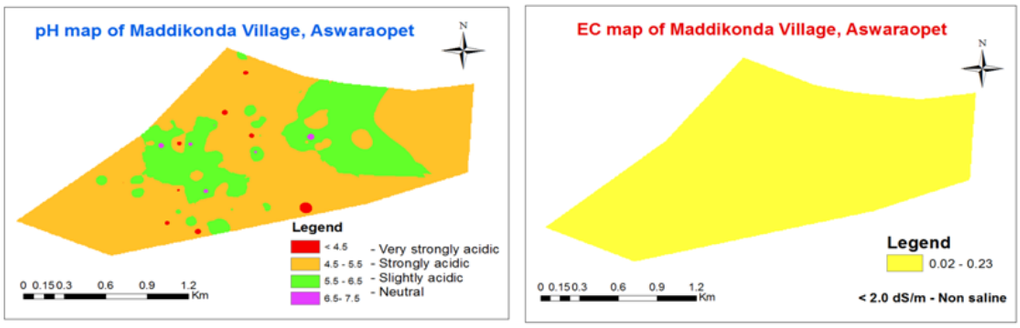

Fig. 1. physico- chemical properties (pH and EC) of Maddikonda village samples.

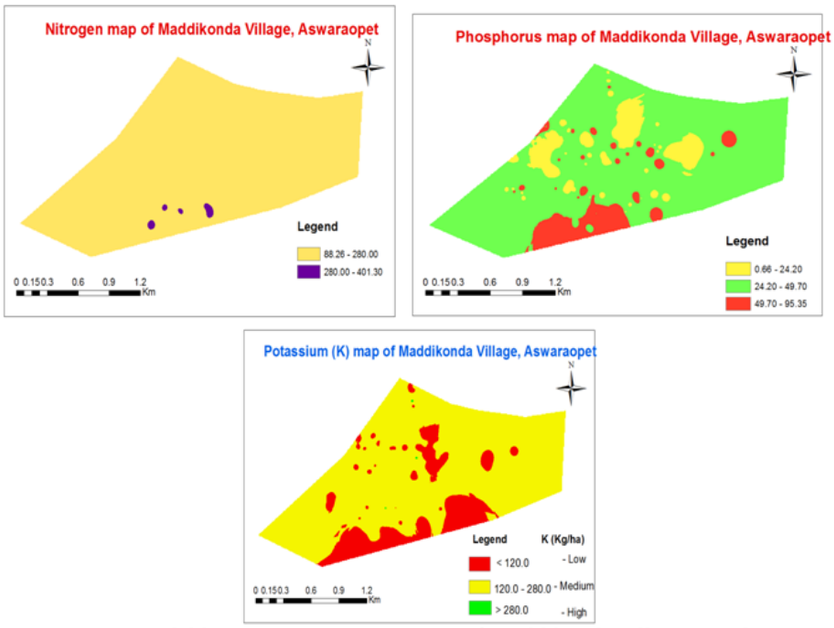

Fig. 2. Available macro nutrients N, P, K of Maddikonda village samples.

Soil potassium concentration is likely to increase due to anthropogenic Wang *et al.*, (2014a) and the present results deviated from the findings of earlier workers. The available potassium status of soils ranged from 57.8 to 310.1 kg ha^{-1} with mean value of 135 kg ha^{-1}. Most of the soils are medium in potassium status due to lesser potassium fertilization. Similar results were also reported by Rajeshwar *et al.* (2009).

C. Correlation between O.C and Available N, P, K

Soil organic carbon is strongly correlated with total nitrogen and this correlation was the terrestrial environment cycle of carbon and nitrogen. Results were in conformity with results obtained from Wibowo and Kasno (2001) and also supported by results obtained by Brevik *et al.* (2018) and there was increase in nitrogen content with soil organic carbon content Sugiyono

(2010). Soil carbon, nitrogen and C/N ratio are negatively correlated with soil pH, suggesting that a relatively low pH favors the accumulation of organic matter (Zhou *et al.*, 2019).

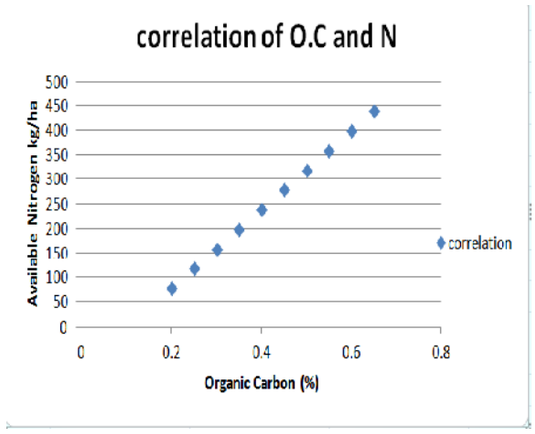

Fig. 4.

There was poor correlation between SOC and (Av. P) with (r=0.401). In the same way exchangeable K also showed poor correlation with organic carbon. Thus, it was concluded that organic carbon (r=0.95) can influence the availability of phosphorous is nearly insignificant while it hardly exists with respect to exchangeable K (Adhikari *et al.*, 2015).

CONCLUSION

From the above results it concluded that Maddikonda village is having neutral to strongly acidic soils which are non saline soil and low in organic carbon content. In terms of macro nutrient content soils are low to medium in nitrogen content, medium to high in phosphorous availability and low to medium in potassium availability. These map details will further, help in fertilizer recommendation and helps in improving the crop yield and sustainability.

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Conflicts of Interest. None.

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